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# Standardization of formulation for preparation of health drink by blending *Aloe vera*, Guava and Jamun

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**Abstract**
Triclosan (TCS) has been widely used as an antibacterial and antifungal agent in household cleaning and personal care products. The widespread use of TCS in the cleaning products poses a potential risk to the ecological system and human health due to its release into sediments, wastewater and ground water resources causing chronic toxicity to aquatic organisms. Therefore, it is necessary to develop a fast, simple, and efficient method for monitoring TCS in the environment. In this article the studies of detection methods for TCS in the environmental samples in recent years are reviewed.

**Keywords:** *Aloe vera*, Guava, Jamun, health drink (Nectar), nutritional and sensory quality

## Introduction
*Aloe vera* is the most widely used and commercially available medicinal plant because of its nutritional and therapeutic properties (Olariu, 2009) [19]. Recently, many commercial food-product manufacturers have initiated the use of *Aloe vera* in their productions. It is useful in curing various diseases such as type II diabetes, arthritis, eye disease, tumor, spleen enlargement, liver complaints, vomiting, bronchitis, asthma, jaundice and ulcers (Henry, 1979) [12]. Many of the medicinal effects of *Aloe vera* have been attributed to its bioactive polysaccharide namely glucomannan or acemannan (Hamid, 2014) [11] while that of Jamun have been attributed to presence of higher anti-oxidant activity (Sehwag and Das, 2014) [27]. However, the most serious and commonly occurring problem in consumption of these commodities in fresh form is due to its bitter taste (*Aloe vera*) and highly acidic as well as astringent taste (Jamun). Guava fruits besides having medicinal importance also possess good flavour and acceptability (Joseph and Priya, 2011) [14]; thus, having positive attribute for blending purpose. Jamun fruits are stomachic and diuretic apart from having cooling and digestive properties. They are also therapeutic possessing anti-diabetic property and brilliant in colour, appearance, refreshing, delicious in taste and nutritious. At present, there is increasing demand for the fat free, low calorie and new emerging foods to prevent us from various degenerative diseases. Keeping all these facts in view, the urgent need was felt to standardize *Aloe vera*, Guava and Jamun blended health drink (Nectar) for the benefit of masses in general and sufferers in particular to lead a healthy normal life without sacrificing their taste perception but combining sensory and nutritional properties. Thus, the experiment was laid to prepare blended health drink using *Aloe vera*, guava and Jamun with different levels of TSS.

## Material and Methods
Fully developed slips of *Aloe vera*, fully ripe fruits of guava and mature fruits of Jamun were procured from Anand and APMC, Navsari (Gujarat) and brought to Department of Post-Harvest Technology, ASPEE College of Horticulture and Forestry, NAU, Navsari, Gujarat during July 2015. Produce *viz*. *Aloe vera*, guava and Jamun were analyzed for various physico-chemical characteristics and used for further experimentation. Juice/ pulp from *Aloe vera*, guava and Jamun were extracted by grating the slips/ fruits following extraction by using crusher & screw type juice extractor and pulper.

Produce juice/ pulp after extraction and filtration were blended in ratio of 2:2:16, 2:4:14, 2:6:12, 4:2:14, 4:4:12, 4:6:10, 6:2:12, 6:4:10 and 6:6:8 (*Aloe vera*: Guava: Jamun) with different TSS level of 15°B & 17°B and maintained with 0.30% acidity followed by heated at 95°C for 5 min. Immediately after pasteurization, the health drink was packed in 200 ml pre-sterilized glass bottles followed by processing in boiling water for 30 min at 96±1°C. The samples followed by labeling were analyzed for physicochemical as well as sensory attributes.

The experiment was carried out by using completely randomized design with factorial concepts including 18 treatments each with 3 replications. Principal steps used for health drink (Nectar) preparation are illustrated in Figure 1.

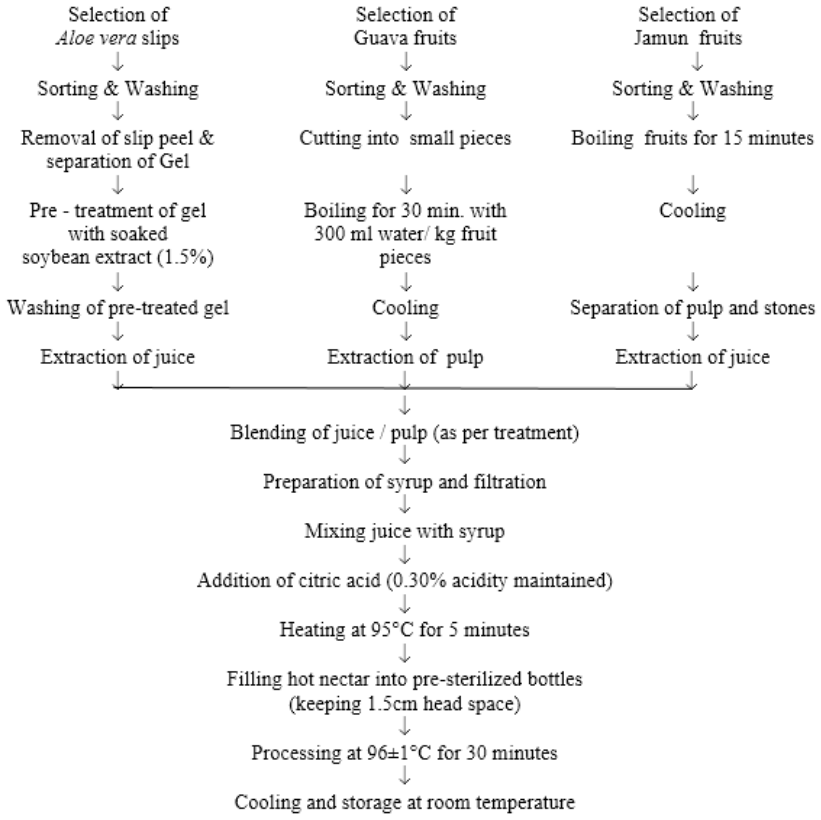


**Fig 1:** Principal steps used for preparation of blended health drink (Nectar)

Morphological parameters of ten sample of each produce were recorded with the help of electronic Vernier calipers. Average weight of produce was determined gravimetrically. The moisture was estimated by drying the weighted samples in hot air oven at 70±2°C to a constant weight (AOAC, 1984) [2]. The yield of the juice was calculated after extraction of the juice and expressed in percentage. The total soluble solids (TSS) was determined with the help of hand refractometer and expressed as °Brix (Ranganna, 1997) [23]. The titratable acidity, sugars and ascorbic acid content were determined by the method as detailed by Ranganna (1997) [23]. Brix acid ratio was calculated by the ratio of TSS and titratable acidity. The pH was measured by a Cambridge pH meter using glass electrode as described by Raj *et al.* (2011) [21]. Total phenols were determined by the method described by Sadasivam and Manickam (1996). The sodium (Na) and potassium (K) contents were estimated by flame photometric method as detailed by Ranganna (1997) [23]. The blended *Aloe vera*, guava and Jamun health drink was evaluated for sensory qualities on the basis of overall acceptability by a panel of 15 judges on a 9-point Hedonic scale Amerine *et al.* (1965) [1]. The data pertaining to physico-chemical characteristics of health drink were analyzed statistically by following completely randomized design with factorial concepts (Panse and Shukhatme, 1967) [20].

## Results and Discussion

The physico-chemical characteristics of fresh *Aloe vera*, guava and Jamun leaves/ fruits are presented in Table 1. Results for physico-chemical parameters are in line with the observations made by Vaghashiya (2015) [35], Boghani *et al.* (2012) [6], Sasikumar *et al.* (2013) [26], Hamid *et al.* (2014) [11] and Ramachandran and Nagarajan (2014) for *Aloe vera*; Vaghashiya *et al*. (2016) [36], Sudhindra *et al.* (2012) [34] and Sharma *et al.* (2009) [9] for guava;, and Sehwag and Das (2014) [27], Shahnawaz and Sheikh (2011) [28] and Sharma *et al*. (2009) [9] for Jamun.

**Table 1:** Physico-chemical properties of *Aloe vera*, Guava and Jamun fruits/ slips

| S. No | Parameters | Mean±SE | | |
|---|---|---|---|---|
| | | ***Aloe vera*** | **Guava** | **Jamun** |
| 1 | Fruit/ Slip Length (cm) | 39.99 ± 7.75 | 5.09 ± 0.61 | 2.69±0.174 |
| 2 | Fruit/ Slip Breadth (cm) | 14.98 ± 1.50 | 5.88± 0.20 | 2.09±0.310 |
| 3 | Fruit/ Slip weight (g) | 192.57± 2.40 | 143.08± 1.95 | 6.70±0.445 |
| 4 | Moisture (%) | 96.98 ± 1.10 | 80.08 ± 0.85 | 80.15±1.14 |
| 5 | Pulp/ Juice recovery (%) | 40.00 ± 0.90 | 81.03 ± 2.50 | 48.00 ± 2.40 |
| 6 | TSS (°B) | 2.14 ± 0.09 | 9.97 ± 0.10 | 15.80±0.490 |
| 7 | Reducing sugars (%) | 0.34 ± 0.04 | 4.58 ± 0.20 | 5.70±0.04 |
| 8 | Non-reducing sugars (%) | 0.29 ± 0.02 | 4.73 ± 0.03 | 8.09±0.07 |
| 9 | Total sugars (%) | 0.59 ± 0.03 | 9.57 ± 0.05 | 14.22±0.09 |
| 10 | Acidity (%) | 0.02 ± 0.003 | 0.35± 0.02 | 1.57±0.025 |
| 11 | pH | 4.00 ± 0.05 | 4.39 ± 0.11 | 3.76±0.015 |
| 12 | Ascorbic acid (mg/100g) | 2.00 ± 0.41 | 283.00± 1.25 | 19.00±0.16 |
| 13 | Sodium (mg/100g) | 49.10±0.60 | 10.80±0.02 | 26.16±0.04 |
| 14 | Potassium (mg/100g) | 127.44±4.7 | 416.00±3.5 | 54.49±2.75 |
| 15 | Phenols (mg/100g) | 12.50±0.71 | 2.50±0.05 | 27.00±0.90 |

### Nutritional quality of health drink (Nectar)

Effect of different formulations on nutritional attributes of prepared health drink has been explained under following captions:

### Total Soluble Solids (TSS)

The perusal of data pertaining to the effect of different treatments on TSS of blended nectar during six months storage has been presented in Table 2. Data revealed that grand mean (B) TSS of blended nectar prepared by mixing different proportion of *Aloe vera*, guava and Jamun juice/ pulp varied significantly from 16.33°B to 16.40°B, with minimum TSS in blended nectar prepared using 4% *Aloe vera* juice, 4% guava pulp and 14%

Jamun juice ($B_4$) and maximum in blend using 6% *Aloe vera* juice, 4% guava pulp and 10% Jamun juice ($B_8$), which is statistically at par with 6% *Aloe vera* juice, 6% guava pulp and 8% Jamun juice ($B_9$). Total soluble solids were significantly affected due to blending ratio during storage (Bhardwaj and Mukherjee, 2012) [5]. Similar results have been reported in mixed fruit juice due to gradual inversion of sugars by hydrolysis (Vaidya *et al.*, 1998) [37]. Similar observations with slight variations were reported earlier by Vaghashiya (2015) [35] and Vaghashiya *et al*. (2016) [36] for TSS of the health drink prepared using *Aloe vera*, bitter gourd, aonla and guava by processing at 96±1ºC for 30 minutes. It is evident from the data that among different levels of TSS, the grand mean (T) TSS of blended nectar significantly varied from 15.36°B to 17.38°B, with minimum TSS in blended nectar prepared by maintaining 15°B TSS ($T_1$) and maximum in blended nectar prepared by maintaining 17°B TSS ($T_2$). The higher TSS in $T_2$ was due to increase in concentration of sugars. Similar observations were also reported earlier for effect of TSS levels on TSS of blended nectar with slight variations by Vaghashiya (2015) [35] and Vaghashiya *et al*. (2016) [36]. Meanwhile, storage of blended nectar resulted significant increase in grand mean (S) TSS from initial value of 16.00°B to 16.71°B after six month of storage. Further, six month old blended nectar prepared using different blending levels observed minimum increase in TSS in blended nectar prepared using 4% *Aloe vera* juice, 2% guava pulp and 14% Jamun juice ($B_4$), whereas, TSS raised to maximum in blended nectar prepared by blend using 6% *Aloe vera* juice, 4% guava pulp and 10% Jamun juice ($B_8$). Bal *et al*. (2014) [4] reported that increase of TSS in the guava nectar was due to conversion of polysaccharides into soluble sugars and formation of water soluble pectin from protopectin. The increase in TSS during six months storage was observed minimum (15.00°B to 15.69°B) in blended nectar by maintaining 15°B TSS ($T_1$) and maximum (17.00°B to 17.74°B) in blended nectar prepared by maintaining 17°B TSS ($T_2$). The increase in TSS might be due to inversion of polysaccharides like starch and cellulose into simpler soluble molecules in the presence of organic acid (Sudhindra *et al.*, 2012) [34]. Similar results were reported by Jakhar and Pathak (2012) [13]. The hydrolysis of polysaccharides into monosaccharides and oligosaccharides causes gradual increase in TSS during storage (Singh and Gaikwad, 2012) [33]. Further, significant differences were observed in TSS of blended nectar during six month storage when blended nectar was prepared using different level of TSS and blending proportion. Similar observations were also reported earlier by Vaghashiya (2015) [35].

**Table 2:** Effect of different treatments on TSS and acidity of blended nectar during the storage period of six months

| Treatments | | TSS ( ° Brix) | | | | | | Acidity (%) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Storage (S) | | | | Grand Mean (T) | Grand Mean (B) | Storage (S) | | | | Grand Mean (T) | Grand Mean (B) |
| TSS (T), °Brix | Blends* (B), % | Initial ($S_1$) | 2 Month ($S_2$) | 4 Month ($S_3$) | 6 Month ($S_4$) | | | Initial ($S_1$) | 2 Month ($S_2$) | 4 Month ($S_3$) | 6 Month ($S_4$) | | |
| $T_1$-15 | $B_1$-2:2:16 | 15.00 | 15.29 | 15.49 | 15.71 | 15.37 | 16.38 | 0.30 | 0.35 | 0.39 | 0.44 | 0.37 | 0.37 |
| | $B_2$-2:4:14 | 15.00 | 15.24 | 15.44 | 15.58 | 15.32 | 16.35 | 0.30 | 0.34 | 0.38 | 0.43 | 0.36 | 0.36 |
| | $B_3$-2:6:12 | 15.00 | 15.30 | 15.51 | 15.72 | 15.38 | 16.38 | 0.30 | 0.36 | 0.41 | 0.44 | 0.38 | 0.37 |
| | $B_4$-4:2:14 | 15.00 | 15.21 | 15.40 | 15.55 | 15.29 | 16.33 | 0.30 | 0.34 | 0.37 | 0.41 | 0.36 | 0.36 |
| | $B_5$-4:4:12 | 15.00 | 15.25 | 15.49 | 15.72 | 15.37 | 16.38 | 0.30 | 0.35 | 0.38 | 0.42 | 0.36 | 0.36 |
| | $B_6$-4:6:10 | 15.00 | 15.32 | 15.54 | 15.73 | 15.40 | 16.38 | 0.30 | 0.34 | 0.39 | 0.43 | 0.36 | 0.36 |
| | $B_7$-6:2:12 | 15.00 | 15.25 | 15.53 | 15.75 | 15.38 | 16.37 | 0.30 | 0.36 | 0.41 | 0.45 | 0.38 | 0.38 |
| | $B_8$-6:4:10 | 15.00 | 15.32 | 15.55 | 15.76 | 15.41 | 16.40 | 0.30 | 0.35 | 0.40 | 0.43 | 0.37 | 0.37 |
| | $B_9$-6:6:8 | 15.00 | 15.30 | 15.50 | 15.69 | 15.37 | 16.40 | 0.30 | 0.35 | 0.39 | 0.42 | 0.36 | 0.36 |
| | Mean | 15.00 | 15.28 | 15.49 | 15.69 | 15.37 | | 0.30 | 0.35 | 0.39 | 0.43 | 0.37 | |
| $T_2$-17 | $B_1$-2:2:16 | 17.00 | 17.29 | 17.52 | 17.74 | 17.39 | | 0.30 | 0.34 | 0.39 | 0.43 | 0.36 | |
| | $B_2$-2:4:14 | 17.00 | 17.26 | 17.53 | 17.75 | 17.39 | | 0.30 | 0.33 | 0.37 | 0.41 | 0.35 | |
| | $B_3$-2:6:12 | 17.00 | 17.26 | 17.53 | 17.75 | 17.39 | | 0.30 | 0.35 | 0.39 | 0.43 | 0.37 | |
| | $B_4$-4:2:14 | 17.00 | 17.27 | 17.51 | 17.72 | 17.38 | | 0.30 | 0.33 | 0.38 | 0.41 | 0.34 | |
| | $B_5$-4:4:12 | 17.00 | 17.25 | 17.53 | 17.76 | 17.39 | | 0.30 | 0.34 | 0.39 | 0.42 | 0.36 | |
| | $B_6$-4:6:10 | 17.00 | 17.30 | 17.49 | 17.70 | 17.37 | | 0.30 | 0.33 | 0.37 | 0.41 | 0.35 | |
| | $B_7$-6:2:12 | 17.00 | 17.28 | 17.48 | 17.70 | 17.37 | | 0.30 | 0.35 | 0.40 | 0.44 | 0.37 | |
| | $B_8$-6:4:10 | 17.00 | 17.30 | 17.51 | 17.72 | 17.38 | | 0.30 | 0.34 | 0.39 | 0.43 | 0.36 | |
| | $B_9$-6:6:8 | 17.00 | 17.33 | 17.56 | 17.78 | 17.42 | | 0.30 | 0.34 | 0.38 | 0.43 | 0.36 | |
| | Mean | 17.00 | 17.28 | 17.52 | 17.74 | 17.38 | | 0.30 | 0.34 | 0.38 | 0.42 | 0.36 | |
| | Grand Mean (S) | 16.00 | 16.28 | 16.51 | 16.71 | 16.37 | | 0.30 | 0.34 | 0.39 | 0.43 | 0.36 | |
| $CD_{0.05}$ | Blends (B) | 0.001 | B × T | 0.015 | | | | Blends (B) | 0.002 | B × T | 0.004 | | |
| | TSS (T) | 0.005 | T × S | 0.001 | B×T×S | 0.030 | | TSS (T) | 0.005 | T × S | 0.003 | B×T×S | 0.006 |
| | Storage (S) | 0.007 | B × S | 0.021 | | | | Storage (S) | 0.003 | B × S | 0.025 | | |
| * *Aloe vera* : Guava : Jamun | | | | | | | | | | | | | |

**Titrable Acidity:** The perusal of data pertaining to the effect of different treatments on acidity of blended nectar during six months storage has been presented in Table 2. Data revealed that grand mean (B) acidity of blended nectar prepared by blending different proportion of *Aloe vera*, guava and Jamun juice/ pulp varied significantly from 0.36 per cent to 0.38 per cent after six month storage, with minimum acidity in blended nectar prepared by blending 4% *Aloe vera* juice, 2% guava pulp and 12% Jamun juice ($B_4$) and maximum in blend using 6% *Aloe vera* juice, 2% guava pulp and 12% Jamun juice ($B_7$). Similar observations with slight variations were reported earlier by Vaghashiya (2015) and Vaghashiya *et al*. (2016) for acidity of the health drink prepared using *Aloe vera*, bitter gourd, aonla and guava by processing at 96±1ºC for 30 minutes. Among different levels of TSS, the grand mean (T) acidity of blended nectar varied significantly from 0.36 per cent to 0.37 per cent, with minimum acidity in blended nectar prepared by maintaining 17°B TSS ($T_2$) and maximum in blended nectar prepared by maintaining 15°B TSS ($T_1$). This could be attributed to utilization of more acids in inversion of sugars in blended nectar prepared with high concentration of sugars thereby decreasing the acidity in $T_2$. Similar observations were also reported earlier for effect of TSS levels on acidity of blended nectar with slight variations by Vaghashiya (2015) [35] and Vaghashiya *et al*. (2016) [36]. The acidity of blended nectar prepared using different blending levels and TSS levels varied significantly, with minimum acidity (0.34%) in blended nectar prepared by using treatment combination $T_2B_4$ at par with $T_1B_4$ and maximum (0.38%) in blended nectar prepared by using treatment combination $T_1B_3$ at par with $T_1B_7$. Data also depict that storage of blended nectar resulted significant increase in

grand mean (S) acidity from initial value of 0.30 per cent to 0.43 per cent after six month of storage. The acidity of blended nectar increased during storage period of six month which might be due to ascorbic acid degradation or hydrolysis of pectin (Chauhan *et al.*, 1997) [7]. Similar results were observed by Karanjalker *et al.* (2013) and Boghani *et al.* (2012) [6]. Further, six month storage of blended nectar prepared using different blending levels resulted increase in acidity which was minimum in blended nectar prepared using 4% *Aloe vera* juice, 2% guava pulp and 14% Jamun juice ($B_4$), whereas, maximum increase in acidity of blended nectar prepared using 6% *Aloe vera* juice, 2% guava pulp and 12% Jamun juice ($B_7$). Increase in acidity during storage of *Aloe vera*, aonla and ginger blended RTS beverage was revealed by Sasikumar *et al.* (2013) [26]. The increase in acidity might be due to formation of organic acid by degradation of ascorbic acid during storage of guava-Jamun blended beverage as explained by Sharma *et al.* (2009) [30]. The increase in acidity during six months storage was observed minimum (0.30% to 0.42%) in blended nectar with 17°B TSS ($T_2$) and maximum (0.30% to 0.43%) in blended nectar prepared by maintaining 15°B TSS ($T_1$). During six month of storage, the acidity of blended nectar prepared using different blending levels and TSS levels increased significantly, with minimum increase (0.30% to 0.34 %) in $T_2B_4$ at par with $T_1B_4$ and maximum (0.30% to 0.38%) in $T_1B_7$. The interaction of TSS, blends and storage possess significant effect on the acidity content of blended nectar. Similar observations were also reported earlier by Vaghashiya (2015) [35].

**Table 3:** Effect of different treatments on reducing sugars and total sugars of blended nectar during the storage period of six months

| Treatments | | Reducing sugars (%) | | | | | | Total sugars (%) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Storage (S) | | | | Grand Mean (T) | Grand Mean (B) | Storage (S) | | | | Grand Mean (T) | Grand Mean (B) |
| TSS (T), °Brix | Blends* (B), % | Initial ($S_1$) | 2 Month ($S_2$) | 4 Month ($S_3$) | 6 Month ($S_4$) | | | Initial ($S_1$) | 2 Month ($S_2$) | 4 Month ($S_3$) | 6 Month ($S_4$) | | |
| $T_1$-15 | $B_1$-2:2:16 | 4.12 | 6.03 | 7.94 | 9.76 | 6.96 | 7.37 | 13.74 | 13.84 | 13.94 | 14.04 | 13.89 | 14.93 |
| | $B_2$-2:4:14 | 4.15 | 6.04 | 7.94 | 9.86 | 7.00 | 7.42 | 13.74 | 13.83 | 13.93 | 14.05 | 13.89 | 14.94 |
| | $B_3$-2:6:12 | 4.09 | 6.00 | 7.93 | 9.82 | 6.96 | 7.39 | 13.69 | 13.80 | 13.89 | 14.00 | 13.85 | 14.85 |
| | $B_4$-4:2:14 | 4.12 | 6.01 | 7.91 | 9.79 | 6.96 | 7.37 | 13.76 | 13.85 | 13.93 | 14.04 | 13.90 | 14.89 |
| | $B_5$-4:4:12 | 4.11 | 6.04 | 7.93 | 9.82 | 6.98 | 7.39 | 13.78 | 13.86 | 13.96 | 14.07 | 13.92 | 14.88 |
| | $B_6$-4:6:10 | 4.14 | 6.06 | 7.96 | 9.85 | 7.00 | 7.39 | 13.83 | 13.92 | 14.02 | 14.13 | 13.98 | 14.96 |
| | $B_7$-6:2:12 | 4.10 | 6.03 | 7.95 | 9.86 | 6.99 | 7.39 | 13.80 | 13.90 | 14.01 | 14.10 | 13.95 | 14.97 |
| | $B_8$-6:4:10 | 4.16 | 6.10 | 7.96 | 9.86 | 7.02 | 7.42 | 13.89 | 14.00 | 14.09 | 14.26 | 14.06 | 15.03 |
| | $B_9$-6:6:8 | 4.14 | 6.09 | 7.95 | 9.84 | 7.01 | 7.42 | 13.85 | 13.83 | 14.02 | 14.13 | 13.96 | 15.00 |
| | Mean | 4.13 | 6.04 | 7.94 | 9.83 | 6.99 | | 13.79 | 13.87 | 13.98 | 14.09 | 13.93 | |
| $T_2$-17 | $B_1$-2:2:16 | 4.79 | 6.82 | 8.81 | 10.71 | 7.78 | | 15.84 | 15.93 | 16.00 | 16.13 | 15.97 | |
| | $B_2$-2:4:14 | 4.80 | 6.86 | 8.89 | 10.79 | 7.84 | | 15.85 | 15.95 | 16.04 | 16.14 | 15.99 | |
| | $B_3$-2:6:12 | 4.74 | 6.79 | 8.90 | 10.86 | 7.82 | | 15.70 | 15.80 | 15.92 | 16.01 | 15.86 | |
| | $B_4$-4:2:14 | 4.77 | 6.76 | 8.79 | 10.79 | 7.78 | | 15.74 | 15.84 | 15.94 | 16.04 | 15.89 | |
| | $B_5$-4:4:12 | 4.78 | 6.80 | 8.83 | 10.81 | 7.81 | | 15.70 | 15.85 | 15.86 | 15.99 | 15.85 | |
| | $B_6$-4:6:10 | 4.76 | 6.78 | 8.80 | 10.79 | 7.78 | | 15.79 | 15.90 | 16.01 | 16.10 | 15.95 | |
| | $B_7$-6:2:12 | 4.80 | 6.79 | 8.80 | 10.82 | 7.80 | | 15.86 | 15.94 | 16.02 | 16.14 | 15.99 | |
| | $B_8$-6:4:10 | 4.81 | 6.82 | 8.83 | 10.84 | 7.83 | | 15.87 | 15.96 | 16.03 | 16.15 | 16.00 | |
| | $B_9$-6:6:8 | 4.82 | 6.83 | 8.85 | 10.86 | 7.84 | | 15.86 | 15.99 | 16.09 | 16.20 | 16.03 | |
| | Mean | 4.79 | 6.81 | 8.83 | 10.81 | 7.81 | | 15.80 | 15.91 | 15.99 | 16.10 | 15.95 | |
| | Grand Mean (S) | 4.46 | 6.43 | 8.39 | 10.32 | 7.40 | | 14.79 | 14.89 | 14.98 | 15.10 | 14.94 | |
| $CD_{0.05}$ | Blends (B) | 0.009 | B × T | 0.013 | | | | Blends (B) | 0.011 | B × T | 0.015 | | |
| | TSS (T) | 0.004 | T × S | 0.008 | B×T×S | NS | | TSS (T) | 0.005 | T × S | 0.010 | B×T×S | 0.030 |
| | Storage (S) | 0.006 | B × S | 0.018 | | | | Storage (S) | 0.007 | B × S | 0.021 | | |
| * *Aloe vera*: Guava: Jamun | | | | | | | | | | | | | |

**Reducing Sugars:** The perusal of data pertaining to the effect of different treatments on reducing sugars of blended nectar during six months storage has been presented in Table 3. Data revealed that grand mean (B) reducing sugars of blended nectar prepared by blending different proportion of *Aloe vera*, guava and Jamun juice/ pulp varied significantly from 7.37 per cent to 7.42 per cent, with minimum reducing sugars in blended nectar prepared by blending 2% *Aloe vera* juice, 2% guava pulp and 16% Jamun juice and ($B_1$) at par with blend prepared using 4% *Aloe vera* juice, 2% guava pulp and 14% Jamun juice ($B_4$), whereas, maximum in blend prepared using 6% *Aloe vera* juice, 4% guava pulp and 10% Jamun juice ($B_8$) at par with blend prepared using 6% *Aloe vera* juice, 6% guava pulp and 8% Jamun juice ($B_9$) and 2% *Aloe vera* juice, 4% guava pulp and 14% Jamun juice. The variation in reducing sugars due to blending was also reported by Kumar *et al.* (2009). This could be attributed to hydrolysis of polysaccharides and inversion of non-reducing sugars during processing and storage (Roy and Singh, 1979. Similar observations with slight variations were reported earlier by Vaghashiya (2015) [35] and Vaghashiya *et al.* (2016) [36] for reducing sugars of the health drink prepared by processing at 96±1ºC for 30 minutes using *Aloe vera*, bitter gourd, aonla and guava. Among different levels of TSS, the grand mean (T) reducing sugars of blended nectar significantly varied from 6.99 per cent to 7.81 per cent, with minimum reducing sugars in blended nectar prepared by maintaining 15°B TSS ($T_1$) and maximum in blended nectar prepared by maintaining 17°B TSS ($T_2$). The variation in reducing sugar content of blended nectar was attributed to variation in the levels of TSS. Similar results have been reported by Sharma *et al.* (2008) [29]. Parallel observations were also reported earlier for effect of TSS levels on reducing sugars of blended nectar with slight variations by Vaghashiya (2015) [35] and Vaghashiya *et al.* (2016) [36]. Storage of blended nectar resulted significant increase in grand mean (S) reducing sugars from initial value of 4.56 per cent to 10.32 per cent after six month of storage. Similar results were observed by Sudhindra *et al.* (2012) [34]. Further, six month storage of blended nectar prepared using different blending levels resulted increase in reducing sugars which was minimum in blended nectar prepared by 2% *Aloe vera* juice, 2% guava pulp and 16% Jamun juice ($B_1$) followed by nectar prepared using 4% *Aloe vera* juice, 2% guava pulp and 14% Jamun juice ($B_4$) whereas, it was maximum in the blend prepared using 6% *Aloe vera* juice, 2% guava pulp and 12% Jamun juice ($B_7$). The increase in reducing sugars during six months storage was minimum (4.13% to 9.83%) in blended nectar prepared by maintaining 15°B TSS ($T_1$) and maximum (4.79% to 10.81%) in blended nectar prepared by maintaining 17°B TSS ($T_2$). This change is attributed to a slow acid hydrolysis of the non-reducing sugars (sucrose) added during preparation of blended nectar, because presence of citric

acid easily hydrolyze sucrose. Similar results were reported in mixed fruit nectar by De Sousa *et al.* (2010) [9]. However, non-significant differences were observed in reducing sugars of blended nectar during six month storage due to different levels of TSS and blending proportion. Similar observations were also reported earlier by Vaghashiya (2015) [35].

**Total Sugars:** The perusal of data pertaining to the effect of different treatments on total sugars of blended nectar during six months storage has been presented in Table 3. Data revealed that grand mean (B) total sugars of blended nectar prepared by blending different proportion of *Aloe vera*, guava and Jamun juice/ pulp varied significantly from 14.85 per cent to 15.03 per cent, with minimum total sugars in blended nectar prepared by mixing 2% *Aloe vera* juice, 6% guava pulp and 12% Jamun juice ($B_3$), whereas, maximum in the blend prepared using 6% *Aloe vera* juice, 4% guava pulp and 10% Jamun juice ($B_8$). Sharma *et al.* (2013) [31] reported that there was a gradual increase in total sugars of guava-Jamun blended RTS and squash during three month storage, which might be due to hydrolysis of polysaccharides like pectin, starch, etc. into simple sugars. Similar observations with slight variations were reported earlier by Vaghashiya (2015) [35] and Vaghashiya *et al*. (2016) [36] for total sugars of the health drink prepared using *Aloe vera*, bitter gourd, aonla and guava by processing at 96±1ºC for 30 minutes. Among different levels of TSS, the grand mean (T) total sugars of blended nectar significantly varied from 13.93 per cent to 15.95 per cent, with minimum total sugars in blended nectar prepared by maintaining 15°B TSS ($T_1$) and maximum in blended nectar prepared by maintaining 17°B TSS ($T_2$). The increase in total sugars in nectar with 17°B TSS ($T_2$) was due to increase in concentration of sugars. Similar observations were reported by Shrivastava *et al.*, (2013) in nectar prepared by maintaining two levels of TSS (20°B and 25°B) after 3 month of storage. Similar observations were also reported earlier for effect of TSS levels on total sugars of blended nectar with slight variations by Vaghashiya (2015) [35] and Vaghashiya *et al*. (2016) [36]. The increase in the total sugars content was attributed to the conversion of insoluble compounds and inversion of non-reducing sugars to reducing sugars by heating (Hamid *et al*., 2014) [11]. Significant differences were observed in total sugars of blended nectar when blended nectar was prepared using different level of TSS and blending proportion. Storage of blended nectar resulted significant increase in grand mean (S) total sugars from initial value of 14.79 per cent to 15.10 per cent after six month of storage. This slight increase in total sugars during storage might be due to acid hydrolysis of polysaccharides as reported by Sudhindra *et al.* (2012) [34]. Attri *et al.* (1991) [3] reported similar findings in blended juice prepared from pear and apricot juice. Further, six month storage of blended nectar prepared by different blending levels resulted increase in total sugars, which was minimum in blended nectar prepared by 4% *Aloe vera* juice, 2% guava pulp and 14% Jamun juice ($B_4$), whereas, maximum in the blend prepared using 6% *Aloe vera* juice, 4% guava pulp and 10% Jamun juice ($B_8$). The increase in total sugars during six months storage was observed minimum (15.80 to 16.10 %) in blended nectar prepared by maintaining 17°B TSS ($T_2$) and maximum (13.79 to 14.09 %) in blended nectar prepared by maintaining 15°B TSS ($T_1$). Further, significant differences were observed in total sugars of blended nectar during six month storage when blended nectar was prepared using different level of TSS and blending proportion. Similar observations were also reported earlier by Vaghashiya (2015) [35].

**Table 4:** Effect of different treatments on ascorbic acid and overall acceptability of blended nectar during the storage period of six months

| Treatments | | Ascorbic acid (mg/100gm) | | | | | | Overall acceptability (9 point Hedonic scale) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Storage (S) | | | | Grand Mean (T) | Grand Mean (B) | Storage (S) | | | | Grand Mean (T) | Grand Mean (B) |
| TSS (T), °Brix | Blends* (B), % | Initial ($S_1$) | 2 Month ($S_2$) | 4 Month ($S_3$) | 6 Month ($S_4$) | | | Initial ($S_1$) | 2 Month ($S_2$) | 4 Month ($S_3$) | 6 Month ($S_4$) | | |
| $T_1$-15 | $B_1$-2:2:16 | 14.95 | 13.44 | 12.39 | 11.40 | 13.04 | 13.66 | 8.41 | 8.18 | 7.79 | 7.32 | 7.93 | 7.71 |
| | $B_2$-2:4:14 | 15.15 | 13.65 | 12.63 | 11.61 | 13.26 | 14.15 | 8.13 | 7.88 | 7.50 | 7.02 | 7.63 | 7.55 |
| | $B_3$-2:6:12 | 15.14 | 13.60 | 12.55 | 11.60 | 13.22 | 14.84 | 8.46 | 8.22 | 7.84 | 7.37 | 7.97 | 7.74 |
| | $B_4$-4:2:14 | 14.95 | 13.41 | 12.42 | 11.49 | 13.07 | 13.91 | 8.73 | 8.47 | 8.12 | 7.72 | 8.26 | 8.13 |
| | $B_5$-4:4:12 | 15.11 | 13.59 | 12.60 | 11.59 | 13.22 | 14.38 | 8.02 | 7.71 | 7.34 | 6.90 | 7.49 | 7.56 |
| | $B_6$-4:6:10 | 16.19 | 14.68 | 13.70 | 12.68 | 14.31 | 15.82 | 7.95 | 7.67 | 7.31 | 6.81 | 7.44 | 7.29 |
| | $B_7$-6:2:12 | 14.97 | 13.46 | 12.44 | 11.45 | 13.08 | 14.23 | 7.61 | 7.37 | 7.06 | 6.59 | 7.16 | 7.32 |
| | $B_8$-6:4:10 | 15.17 | 13.65 | 12.64 | 11.60 | 13.26 | 14.65 | 7.75 | 7.51 | 7.20 | 6.73 | 7.23 | 7.13 |
| | $B_9$-6:6:8 | 16.17 | 14.70 | 13.66 | 12.70 | 14.31 | 15.74 | 7.99 | 7.74 | 7.37 | 6.88 | 7.50 | 7.35 |
| | Mean | 15.31 | 13.80 | 12.78 | 11.79 | 13.42 | | 8.12 | 7.86 | 7.50 | 7.03 | 7.62 | |
| $T_2$-17 | $B_1$-2:2:16 | 16.20 | 14.65 | 13.64 | 12.61 | 14.27 | | 8.03 | 7.72 | 7.33 | 6.92 | 7.50 | |
| | $B_2$-2:4:14 | 16.90 | 15.43 | 14.43 | 13.40 | 15.04 | | 8.02 | 7.68 | 7.30 | 6.85 | 7.46 | |
| | $B_3$-2:6:12 | 18.36 | 16.84 | 15.82 | 14.77 | 16.45 | | 8.02 | 7.73 | 7.39 | 6.93 | 7.52 | |
| | $B_4$-4:2:14 | 16.61 | 15.13 | 14.15 | 13.13 | 14.75 | | 8.50 | 8.21 | 7.83 | 7.46 | 8.00 | |
| | $B_5$-4:4:12 | 17.45 | 15.93 | 14.90 | 13.86 | 15.53 | | 8.17 | 7.86 | 7.49 | 7.00 | 7.63 | |
| | $B_6$-4:6:10 | 19.15 | 17.70 | 16.70 | 15.74 | 17.32 | | 7.66 | 7.38 | 7.00 | 6.51 | 7.14 | |
| | $B_7$-6:2:12 | 17.27 | 15.78 | 14.77 | 13.70 | 15.38 | | 8.00 | 7.71 | 7.35 | 6.87 | 7.48 | |
| | $B_8$-6:4:10 | 17.91 | 16.42 | 15.43 | 14.39 | 16.04 | | 7.56 | 7.26 | 6.86 | 6.42 | 7.03 | |
| | $B_9$-6:6:8 | 19.08 | 17.60 | 16.59 | 15.40 | 17.17 | | 7.79 | 7.43 | 7.06 | 6.55 | 7.20 | |
| | Mean | 17.66 | 16.16 | 15.16 | 14.11 | 15.77 | | 7.97 | 7.66 | 7.29 | 6.84 | 7.44 | |
| | Grand Mean (S) | 16.49 | 14.98 | 13.97 | 12.95 | 14.60 | | 8.04 | 7.76 | 7.40 | 6.94 | 7.53 | |
| $CD_{0.05}$ | Blends (B) | 0.008 | B × T | 0.025 | | | | Blends (B) | 0.020 | B × T | 0.026 | | |
| | TSS (T) | 0.003 | T × S | 0.013 | B×T×S | 0.041 | | TSS (T) | 0.007 | T × S | 0.018 | B×T×S | 0.052 |
| | Storage (S) | 0.009 | B × S | 0.022 | | | | Storage (S) | 0.012 | B × S | 0.040 | | |
| * *Aloe vera* : Guava : Jamun | | | | | | | | | | | | | |

**Ascorbic Acid:** The perusal of data pertaining to the effect of different treatments on ascorbic acid of blended nectar during six months storage has been presented in Table 4. Data revealed that grand mean (B) ascorbic acid of blended nectar prepared by blending different proportion of *Aloe vera*, guava and Jamun juice/pulp varied significantly from 13.66 mg/100g to 15.82 mg/100g, with minimum ascorbic acid in blended nectar prepared by mixing 2% *Aloe vera* juice, 2% guava pulp and 16% Jamun juice ($B_1$) and maximum in the blend prepared using 4% *Aloe vera* juice, 6% guava pulp and 10% Jamun juice ($B_6$). The variation in ascorbic acid content in different blends might be due to variation in initial ascorbic acid content of produce. However, Yadav *et al.* (2013) [38] reported that the ascorbic acid of *Aloe vera* RTS beverage supplemented with mint and ginger

decreased during 60 days of storage which might be due to the oxidation of the ascorbic acid to dehydro-ascorbic acid. Similar results were observed by Elbandy *et al.* (2014) [10] and Karanjalker *et al*. (2013) [16]. Most likely observations were reported earlier by Vaghashiya (2015) [35] and Vaghashiya *et al*. (2016) [36] for ascorbic acid of the health drink prepared using *Aloe vera*, bitter gourd, aonla and guava by processing at 96±1ºC for 30 minutes. Among different levels of TSS, the grand mean (T) ascorbic acid of blended nectar significantly varied from 13.42 mg/100g to 15.77 mg/100g, with minimum ascorbic acid in blended nectar prepared by maintaining 15°B TSS ($T_1$) and maximum in blended nectar prepared by maintaining 17°B TSS ($T_2$). Similar observations were also reported earlier for effect of TSS levels on ascorbic acid of blended nectar with slight variations by Vaghashiya (2015) [35] and Vaghashiya *et al*. (2016) [36]. The ascorbic acid of blended nectar prepared using different blending levels and TSS levels varied significantly, with minimum ascorbic acid (13.04 mg/100g) in nectar prepared by using treatment combination $T_1B_1$ and maximum (17.32 mg/100g) in blended nectar prepared using treatment combination $T_2B_6$. Storage of blended nectar resulted significant decrease in grand mean (S) ascorbic acid from initial value of 16.49 mg/100g to 12.95 mg/100g after six month of storage. The ascorbic acid content of the juice decreased during storage, which was probably due to the fact that ascorbic acid being sensitive to oxygen, light and heat was easily oxidized in presence of oxygen (Mapson, 1970) [18]. Because of the high vitamin C content of acerola, cashew apple and guava fruits, which were present in the nectar, despite high loss during processing and storage, the beverages can still be considered a good source of vitamin C (DeSousa *et al.*, 2010) [9]. Further, six month storage of blended nectar prepared by different blending levels resulted decrease in ascorbic acid which was minimum in blended nectar prepared using 4% *Aloe vera* juice, 2% guava pulp and 14% Jamun juice ($B_4$), whereas, maximum decrease in ascorbic acid of blended nectar prepared using 6% *Aloe vera* juice, 6% guava pulp & 8% Jamun juice ($B_9$). It might be due to good anti-oxidant activity of Jamun. The polyphenols along with bioactive polysaccharides like acemannan and glucomannan could protect vitamins from oxidation and loss (Zheng and Wang, 2001) [39]. The decrease in ascorbic acid during six months storage was observed minimum (15.31 mg/100g to 11.79 mg/100g) in blended nectar prepared by maintaining 15°B ($T_1$) and maximum (17.66 mg/100g to 14.11 mg/100g) in blended nectar prepared by maintaining 17°B TSS ($T_2$). Similar results reported by Sudhindra *et al*. (2012) [34] wherein the ascorbic acid content decreased during storage period in recipes of blended guava, *Aloe vera* and roselle RTS and nectar. Significant differences were observed in ascorbic acid content during six month storage when blended nectar was prepared using different level of TSS and blending proportion. During six month of storage, minimum decrease in ascorbic acid content (14.95 mg/100g to 11.49 mg/100g) was observed in nectar prepared by using treatment combination $T_1B_4$ and maximum (19.08 mg/100g to 15.40 mg/100g) in nectar prepared by using treatment combination $T_2B_9$. The interaction of TSS, blends and storage possess significant effect on the ascorbic acid content of blended nectar. Similar observations were also reported earlier by Vaghashiya (2015) [35].

**Sensory quality of health drink (Nectar)**

Effect of different formulations on nutritional attributes of prepared health drink has been explained under following captions:

**Overall Acceptability:** The perusal of data pertaining to the effect of different treatments on overall acceptability score (9 point Hedonic Scale) of blended nectar during six months storage has been presented in Table 4. Data revealed that grand mean (B) overall acceptability score of blended nectar prepared by blending different proportion of *Aloe vera*, guava and Jamun juice / pulp varied significantly from 7.13 to 8.13, with minimum overall acceptability score in blended nectar prepared using 6% *Aloe vera* juice, 4% guava pulp and 10% Jamun juice ($B_8$) and maximum in blend using 4% *Aloe vera* juice, 2% guava pulp and 14% Jamun juice ($B_4$). Similar observations with slight variations were reported earlier by Vaghashiya (2015) [35] and Vaghashiya *et al*. (2016) [36] for flavour of the health drink prepared using *Aloe vera*, bitter gourd, aonla and guava by processing at 96±1ºC for 30 minutes. Among different levels of TSS, the grand mean (T) overall acceptability score of blended nectar significantly varied from 7.44 to 7.62, with minimum overall acceptability score in blended nectar prepared by maintaining 17°B TSS ($T_2$) and maximum overall acceptability score in blended nectar prepared by maintaining 15°B TSS ($T_1$). Similar observations were also reported earlier for effect of TSS levels on overall acceptability of blended nectar with slight variations by Vaghashiya (2015) [35] and Vaghashiya *et al*. (2016) [36]. However, Sudhindra *et al.* (2012) [34] reported that blending of *Aloe vera* and guava can be used to prepare organoleptically best quality nectar using 20% juice having 20°B TSS and 0.25% acidity. It could be due to better combination effect provided by the *Aloe vera* juice to guava pulp. Significant differences were observed in overall acceptability score of blended nectar prepared using different level of TSS and blending proportion. Storage of blended nectar resulted significant decrease in grand mean (S) overall acceptability score from initial value of 8.04 to 6.94 after six month of storage. The storage study of guava (cv. Lalit) nectar revealed decrease in sensory score for overall acceptability. This might be due to oxidative reactions that deteriorate the scores of colour, flavour as well as taste. These findings were in accordance with Kalra and Tandon (1984) and Choudhary *et al.* (2008). Further, six month storage of blended nectar prepared by different blending levels resulted minimum decrease in overall acceptability score of blended nectar prepared by blend using 4% *Aloe vera* juice, 2% guava pulp and 14% Jamun juice ($B_4$), whereas, maximum decrease in overall acceptability score of blended nectar prepared using 6% *Aloe vera* juice, 6% guava pulp and 8% Jamun juice ($B_9$). Sasikumar *et al.* (2013) [26] reported that overall sensorial quality profile of blended (*Aloe vera*, aonla and ginger) therapeutic RTS slightly decreased during storage period of four months, though remained under the consideration of "Like very much" by panel members. The decrease in overall acceptability score during six months storage was observed minimum (8.12 to 7.03) in blended nectar prepared by maintaining 15°B TSS ($T_1$) and maximum (7.97 to 6.84) in blended nectar prepared by maintaining 17°B TSS ($T_2$). Significant differences were observed in overall acceptability score of blended nectar during six month storage due to different levels of TSS and blending proportion. During six months storage, minimum decrease (8.73 to 7.72) was observed in blended nectar prepared using treatment combination $T_1B_4$ and maximum decrease (7.79 to 6.55) in drink prepared by using treatment combination $T_2B_9$. The interaction of TSS, blends and storage possess significant differences in overall acceptability score of blended nectar. Similar observations were also reported earlier by Vaghashiya (2015) [35].

**Conclusion**

The findings summarized above indicate that health drink (Nectar) can be prepared by 4 per cent *Aloe vera*, 2 per cent guava and 14 per cent Jamun having TSS of 15.00°Brix and 0.30 per cent acidity. The prepared nectar can be stored successfully for a period of six months in glass bottle at room temperature. Thus, the developed technologies can commercially be explored by food processing industry for the production of quality *Aloe vera* based blended health drink.

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